

5450ndr1va2_00014372

Doug
Wendy
Kevin
Steve
Shab (?)
Joan

EPA Act Program Update for DOE

Status and Budget

• OBD J1979 std options
March 4, 2009

- manufacturer-specific options
 - ↳ LTFT is here for some vehicles
 - ↳ options vary

Do Not Cite or Distribute

1

Status of Testing and Fuel Blending

- Phase 1 testing complete
 - 75°F testing of 19 vehicles on 3 fuels (E0, E10, E15)
- Interim FTP-cycle testing complete
 - 75°F testing of 6 vehicles on 3 fuels (E0, E10, E15)
- Phase 2 testing complete
 - 50°F testing of 19 vehicles on 3 fuels (E0, E10, E15)
- Currently preparing to launch Phase 3 (main fuel matrix) with reduced scope due to uncertain funding
 - 75°F testing of 10? (originally 19) vehicles on 26 fuels (E0, E10, E15, E20)
- Test fuel development being done by Haltermann and ASD
 - EPA defines fuel recipes
 - Haltermann prepares hand blends, bulk blends and performs fuel analyses
- 22 of the 26 fuels needed in Phase 3 have been blended in bulk
 - 13 have been delivered to SWRI

Do Not Cite or Distribute

2

Plan as of 3/4: reduce toxic's specification to Rich's 6 or 7 fuels,
(Per Paul) and to first lot (no replicates) only

↳ need to get ok from Kathryn, Rich

1

Test Results to Date

- Preliminary Results for 75°F
 - Decrease in cold start NOx for E10 and E15 compared to E0
 - No statistically significant change in overall NOx emission for composite drive cycle
 - Decrease in CO and HC emissions in composite drive cycle
 - PM results are mixed, no clear trends
 - Acetaldehyde and ethanol emissions increase with fuel ethanol level
 - Findings are consistent with DOE's mid-level blends report

Do Not Cite or Distribute

3

Phase 1 Criteria Emission Impacts

(Categorical Analysis via Mixed Model, $p \leq 0.05$ or $p \leq 0.10$)

	E10 vs. E0 Relative Difference (%)				E15 vs. E0 Relative Difference (%)			
	Bag 1	Bag 2	Bag 3	Comp	Bag 1	Bag 2	Bag 3	Comp
NOx	-21.6			-10.2	-18.3			-9.8
THC	-11.1		-27.8	-13.8				-13.3
CO	-14.6		-35.6	-12.8	-16.4		-30.5	-14.5
NMHC	-13.3		-38.1	-1.3			-35.4	-0.9
CO2	-1.5	-1.3	+1.0		-0.8	-0.9	-0.6	
PM		-17.3	30.4		24.8		59.4	

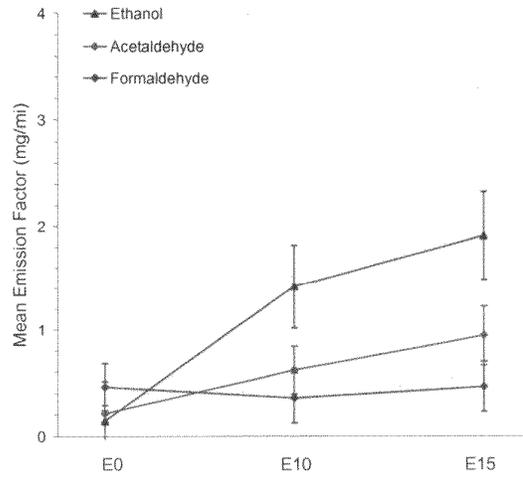
	E15 vs. E10 Relative Difference (%)			
	Bag 1	Bag 2	Bag 3	Comp
NOx				
THC				
CO				
NMHC				
CO2	0.7			0.4
PM	21.9			18.5

Day
 run these
 #15 for
 over 15' or 90
 & see the same
 effect?

Do Not Cite or Distribute

4

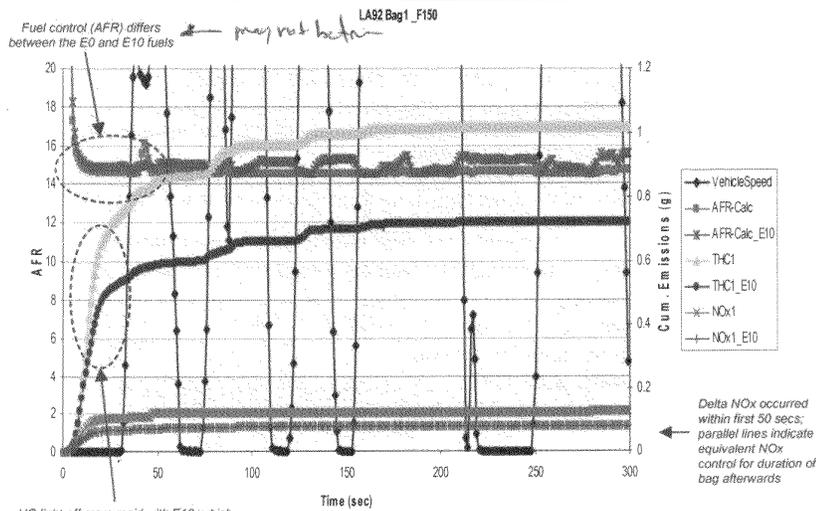
Effects on Key Toxics



Do Not Cite or Distribute

5

Example of modal and OBD data showing source of emissions changes between E0 and E10 fuels for one vehicle



Do Not Cite or Distribute

6

Caveats to Phase 1 Results

- Phase 1 fuels were chosen to approximately represent how in-use ethanol blends might look in an RFS2 world
 - Goal was to get a preview of ethanol impacts for RFS2 proposal
- However, **multiple properties change between these fuels besides ethanol level**
 - Resulting dataset cannot be used to assign quantified emission effects to ethanol specifically without the rest of the data from Phase 3
 - Meaningful fuel effects modeling cannot be done using resulting dataset alone

PROPERTY	UNIT	METHOD	FUEL		
			E0	E10	E15
Ethanol Content	vol. %	D5599	<0.1	9.35	14.5
T50	°F	D86	215	209	182
T90	°F	D86	324	319	310
RVP	psi	D5191	9.17	9.05	8.91
Aromatics	vol. %	D1319	29.3	22.9	18.7
Olefins	vol. %	D1319	6.4	5.7	5.8
Benzene	vol. %	D3606	0.48	0.49	0.46
S	mg/kg	D5453	23	23	21
RON	-	D2699	93.4	93.7	93.9
MON	-	D2700	83.5	84.9	84.6
(R + M)/2	-	Calc.	88.5	89.3	89.2

Do Not Cite or Distribute

7

Budget Considerations Going Forward

- Current program cost estimates significantly exceed original projections
 - Unrealistically low original cost estimates by SWRI
 - Underestimation of base program cost: **Ex. 4 - CBI**
 - Base program cost estimate went up by **Ex. 4 - CBI** between January 7, 2009 and February 5, 2009
 - Unexpectedly high cost of "coming up to speed": **Ex. 4 - CBI**
 - Additional checkout tests to resolve HC analyzer saturation and secondary dilution ratio issues in Phase 2: **Ex. 4 - CBI**
 - Higher than originally estimated test replication rate: **Ex. 4 - CBI**
 - Fuel cost increase (modified fuel development protocol): **Ex. 4 - CBI**
 - Additional tasks:
 - EFM resolution: **Ex. 4 - CBI** *about use SAO*
 - Fuel matrix redesign: **Ex. 4 - CBI**
 - FTP testing: **Ex. 4 - CBI** *also Innova cost savings list*
- Current shortfall: **Ex. 4 - CBI**

Do Not Cite or Distribute

8

Options to Reduce Cost

- Delay testing of CRC fuels: \$195,000
- Reduce the number of test fuels *↳ increasing T90 effect*
 - Reduction of the number of fuels by 1 would drop the G-efficiency of emission models below the minimum acceptable limit of 50%
 - Coverage drops, fuel effects become confounded very fast
- Reduce the number test vehicles
 - Reduction of the number of vehicles from 19 to 15 doubles the probability of getting a non-significant result in emission models. The power of the statistical test of 0.80 is the lowest acceptable in std practice (0.95 was used in AutoOil) *↳ 10 veh = 0.7 power*
 - Reducing the number of test replicates from 2 to 1 has an even stronger impact
- Eliminate continuous THC, NOx.... measurements in raw exhaust
 - Would make critical types of information unavailable
 - Minimal savings
- Reduce the scope of exhaust HC speciation
 - Data necessary for AQ modeling and toxic emission factors
 - * • Phase I and II data not adequate due to fuel blending problems
- Work with SWRI to reduce program cost
- Obtain additional EPA funds
- Request additional DOE support *Do Not Cite or Distribute*



EPAct Cost Estimator

Item	Cost	Comments
Cost of Phase 3 (lower limit) - EPA estimate	\$	EPA funds
Funds currently available from the EPA	\$	
Additional funds from EPA		TBD
Funds "released" by DOE due to reduced scope of Phase 3	\$	
Additional funds from DOE		TBD
Scaling back of the number of vehicles to 15	\$	Ex. 4 - CBI
Scaling back of exhaust HC speciation by 50%	\$	
Elimination of continuous THC, NOx..... measurements in raw exhaust		
Total	\$	minimal
Additional funding needed to test 15 vehicles while scaling back HC speciation by 50%	\$	

Doug supports speciation
 fuel effects

Do Not Cite or Distribute



G-EFF = THE "GOODNESS" EFFICIENCY

3/10 @ 3 PM

↳ DOE wants to reconvene now 3/9 or 3/10 to discuss

Back-up Slides

Do Not Cite or Distribute

11

Revised EPA Act Fuel Matrix

Fuel #	T50	T90	ETOH	RVP	ARO
	°F	°F	%	psi	%
1	150	300	10	10	15
2	240	340	0	10	15
3	220	300	10	7	15
4	220	340	10	10	15
5	240	300	0	7	40
6	190	340	10	7	15
7	190	300	0	7	15
8	220	300	0	10	15
9	190	340	0	10	40
10	220	340	10	7	40
11	190	300	10	10	40
12	150	340	10	10	40
13	220	340	0	7	40
14	190	340	0	7	15
15	190	300	0	10	40
16	220	300	10	7	40
17	215	325	0	9	30
18	202	325	10	9	25
19	195	325	15	9	23
20	160	300	20	7	15
21	160	300	20	7	40
22	160	300	20	10	15
23	160	340	20	7	15
24	160	340	20	10	15
25	160	340	20	10	40
26	150	340	15	10	40
27	190	340	15	7	15
28	190	300	15	7	40
29	TBD	TBD	85	TBD	TBD
30	150	325	10	10	40
31	160	325	20	10	15

Phase 3 Base Program (EPA) (Fuels 1-16) →

Phases 1 and 2 RFS 2 Subset (EPA/DOE) (Fuels 17-19) →

Phase 3 Additional Fuels (DOE) (Fuels 20-29) →

E85 (DOE) →

CRC Additional Fuels →

Revised Fuels

Do Not Cite or Distribute

12

Projected Schedule Going Forward

- Launch of Phase 3 testing: Mid-February 2009
- Completion of Phase 3 testing: Early December 2009
- Reporting: December 2009 – mid-March 2010

		JAN 2009	FEB 2009	MAR 2009	APR 2009	MAY 2009	JUN 2009	JUL 2009	AUG 2009	SEP 2009	OCT 2009	NOV 2009	DEC 2009
		3 12 19 26	2 9 16 23	2 9 16 23 30	6 13 20 27	4 11 18 25	1 8 15 22 29	6 13 20 27	3 10 17 24 31	7 14 21 28	5 12 19 26	2 9 16 23 30	7 14 21 28
Phase 1*	14 weeks												
SOP setup	3 weeks												
Phase 2*	9 weeks												
SOP teardown	2 weeks												
Phase 3*	26 weeks												
NREL fuels*	17 weeks			1 2 3 4 5 6 7	8 9 10 11	12 13 14 15	16 17 18 19 20	21 22 23 24 25 26					
CRC fuels	4 weeks								1 2 3 4	5 6 7	8 9 10 11	12 13 14 15 16	17
NREL high emitter	2 weeks												28 29
draft final report	5 weeks												1 2 3
EPANREL review	4 weeks												
final report	4 weeks												

		JAN 2010	FEB 2010	MAR 2010	APR 2010	MAY 2010	JUN 2010	JUL 2010	AUG 2010	SEP 2010	OCT 2010	NOV 2010	DEC 2010
		3 12 19 26	2 9 16 23	2 9 16 23 30	6 13 20 27	4 11 18 25	1 8 15 22 29	6 13 20 27	3 10 17 24 31	7 14 21 28	5 12 19 26	2 9 16 23 30	7 14 21 28
Phase 1*	14 weeks												
SOP setup	3 weeks												
Phase 2*	9 weeks												
SOP teardown	2 weeks												
Phase 3*	26 weeks												
NREL fuels*	17 weeks												
CRC fuels	4 weeks												
NREL high emitter	2 weeks												
draft final report	5 weeks												
EPANREL review	4 weeks												
final report	4 weeks												

Do Not Cite or Distribute

13